PROC. BIOL. SOC. WASH.
104(2), 1991, pp. 309–316

PROCAMBARUS (*GIRARDIELLA*) *STEIGMANI*, A NEW CRAYFISH (DECAPODA: CAMBARIDAE) FROM A LONG-GRASS PRAIRIE IN NORTHEASTERN TEXAS

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Abstract.—*Procambarus* (*Girardiella*) *steigmani*, a crayfish which appears to be a habitual (primary) burrower, is described from a single locality on the Parkhill Prairie, in the Trinity River watershed of Collin County, Texas. Its closest relative, from which it differs in possessing asymmetrical first pleopods in the male and a highly sculptured annulus ventralis in the female, is *P.* (*G.*) *regalis* which has been reported from the Ouachita and Red river basins of southwestern Arkansas.

Described herein is *Procambarus* (*G.*) *steigmani*, the third previously undescribed member of the subgenus *Girardiella* to be recognized since Hobbs & Robison (1988) reviewed the occurrence of the genus in Arkansas and presented a key and illustrations to aid in the recognition of the 10 then-known members of the *gracilis* group of the subgenus. *Procambarus* (*G.*) *kensleyi* and *P.* (*G.*) *nigrocinctus*, both rather distantly related to *P.* (*G.*) *steigmani*, were subsequently described by Hobbs (1990) from the Neches River basin of eastern Texas. The new species is closely allied to *P.* (*G.*) *regalis* Hobbs & Robison, 1988, from southwestern Arkansas, sharing so many features in common with that species that I am tempted to recognize it as a subspecies of the latter. Until more is known about the ranges of the two, the treatment proposed here seems to me, however, to be based on fewer assumptions.

An error is present in the key mentioned above (Hobbs & Robison 1988:404): at the end of couplet 2, “6” should read “7” and, at the end of couplet 5, “6” should replace “7.” Using this key with the corrections noted, *P.* (*G.*) *steigmani* would be identified as *P.* (*G.*) *regalis* from which it may be distinguished readily by its possessing asymmetrical first pleopods, a feature apparently unique in the subgenus.

Procambarus (*Giradiella*) *steigmani*, new species
Figs. 1, 2

Crayfish.—Eig, 1990:1A, 5A, unnumbered color photograph.

Diagnosis.—Body pigmented, eyes well developed. Rostrum lacking marginal spines, tubercles, and median carina. Carapace without cervical spines or tubercles. Areola often linear but never less than 45.5 times as long as wide and constituting 37.4 to 41.9 ($\bar{X} = 40.1$) % of total length of carapace (44.6 to 47.6, $\bar{X} = 46.0$% of postorbital carapace length). Suborbital angle weak and obtuse. Hepatic and mandibular areas weakly tuberculate; branchiostegal spine absent. Antennal scale about 2.4 times as long as broad, widest distal to midlength. Ventral surface of palm of chela punctate mesially and laterally (rarely with single small tubercle ventromesially), no tubercles on ventral surface of dactyl. Ischium of third pereiopod of first form male with simple strong hook overreaching basioischial articulation; hook not opposed by tubercle on corresponding basis; coxa of fourth pereio-

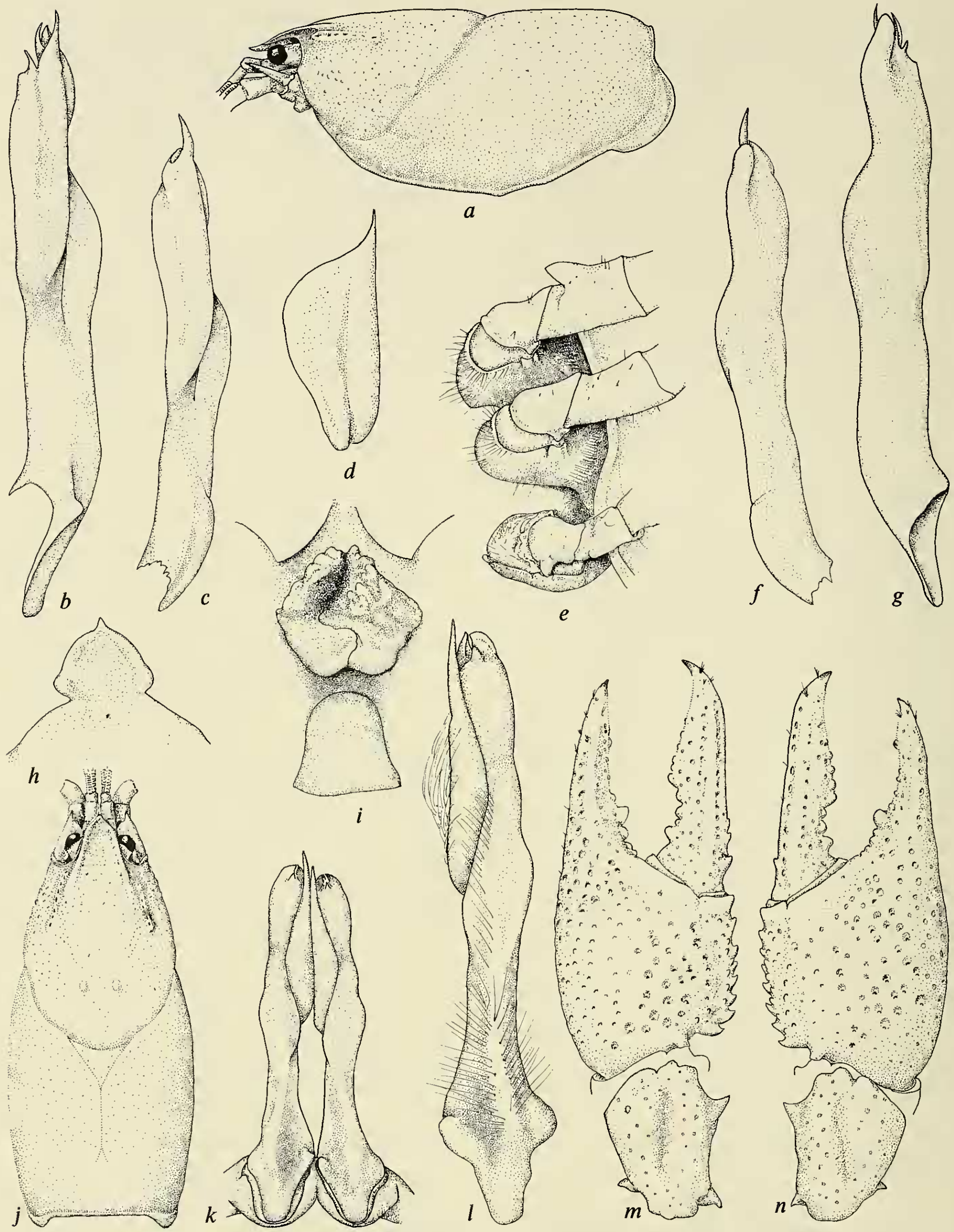

Fig. 1. *Procambarus* (*Girardiella*) *steigmani*, new species (holotype except c, f from morphotype, and i, m from allotype): a, Lateral view of carapace; b, c, Mesial view of first pleopod; d, Antennal scale; e, Basal podomeres of third, fourth, and fifth pereiopods; f, g, Lateral view of first pleopod; h, Cephalomedian lobe of epistome; i, Annulus ventralis and adjacent sternites; j, Dorsal view of carapace; k, l, Caudal view of first pleopods; m, n, Dorsal view of distal podomeres of cheliped.

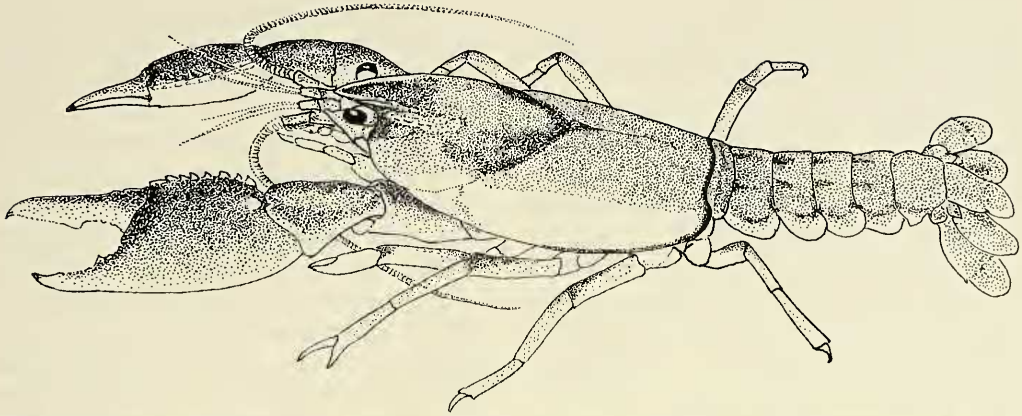

Fig. 2. Dorsolateral view of paratypic male, form I, *Procambarus* (*Girardiella*) *steigmani*, new species, illustrating color pattern.

pod lacking caudomesial boss. First pleopods of first form male reaching coxae of third pereiopods, asymmetrical, bearing tuberculiform proximomesial spur, angular sloping shoulder at base of terminal elements, and lacking subterminal setae; terminal elements, all at least partly sclerotized, consisting of: (1) straight to slightly curved, spiculiform mesial process overreaching other terminal elements; (2) short, acute, cephalodistally directed cephalic process situated at cephalolateral base of mesial process; (3) strong cornified obliquely flattened and caudodistally directed central projection; and (4) caudal element consisting of rounded, obliquely disposed, lamelliform lobe with mesiodistal angle and small, adnate, thumb-like lobe on caudomesial base of latter. Central projection slightly overreaching caudal element. Female with annulus ventralis freely movable, slightly broader than long, subsymmetrical in outline; deep cephalomedian trough leading to sigmoid sinus ending on caudal wall of annulus; anterolateral prominences highly sculptured and bearing prominent tubercles. Preannular plate obscure; postannular sclerite weakly tapering anteriorly and with anterior third sloping conspicuously dorsally; first pleopods present.

Holotypic male, form I.—Cephalothorax (Figs. 1a, j, 2) subovate, compressed laterally. Second abdominal segment narrower than thorax. Areola linear along most of its length. Cephalic section of carapace 1.2 times as long as areola, latter comprising 41.9% of total length of carapace (47.4% of postorbital carapace length). Surface of carapace smooth to punctate dorsally, weakly granulate ventrolaterally and sparsely tuberculate in hepatic and mandibular regions. Rostrum with thickened margins tapering from broad base to short acumen, latter indistinctly delimited basally; slightly upturned tip of acumen reaching midlength of penultimate podomere of antennular peduncle; dorsal surface concave anteriorly becoming subplane toward base and with few conspicuous punctations between those on mesial flank of ridges; subrostral ridges moderately prominent and evident in dorsal aspect to base of acumen. Postorbital ridges prominent, swollen posteriorly, deeply grooved laterally but weakly elevated dorsally, and lacking spines and tubercles. Paired posterior gastric prominences moderately conspicuous. Suborbital angle obtuse. Branchiostegal and cervical spines lacking.

Abdomen shorter than carapace. Pleura of third through fifth segments broadly rounded ventrally. Cephalic section of telson with 2 spines on right (3 on left) caudolateral corner, more lateral one on both sides immovable. Cephalic lobe of epistome (Fig. 1h) campanulate in outline with small apical projection; elevated margins thickened, median area subplane; main body of epistome with fovea; epistomal zygoma arched. Ventral surface of proximal podomere of antennular peduncle with strong spine near midlength. Antennal peduncle lacking spines and prominent tubercles on three proximal podomeres; flagella broken but reaching second abdominal tergum in morphotype. Antennal scale (Fig. 1d) 2.4 times as long as wide, broadest distal to midlength; greatest width of lamellar area about twice that of thickened lateral part.

Third maxilliped extending anteriorly to level of ultimate podomere of antennule; ventral surface moderately setose, setae on mesial half of ischium and row on ventral surface of merus conspicuous, those extending mesially from sublateral row smaller and fewer in number; merus not completely obscured by setae in lateral aspect.

Right chela (Fig. 1n) subovate in cross section, depressed; width of palm 1.3 times length of mesial margin; latter slightly greater than ⅓ length of chela; except mesially and dorsomesially, palm mostly punctate although dark coloration of small, recessed tubercles over much of dorsolateral surface presenting erroneous first impression of its being strongly tuberculate. Mesial surface of palm with row of 7 cream-colored tubercles flanked dorsolaterally by irregular row of 8 almost black ones, and arc of 6 dark ones situated more laterally; no tubercles present on ventral flank of mesialmost row. Both fingers with poorly defined median longitudinal ridges dorsally and ventrally; ridges made evident largely by bordering punctuations. Opposable margin of fixed finger with row of 5 (4 on left) tubercles (distalmost largest on finger) on proximal fourth of finger, followed by row of 4 (3 on left) small ones along middle third, and abraded, more ventral, large one at base of distal fourth of finger; single row of minute denticles extending from largest tubercle to base of corneous tip of finger; lateral surface of finger rounded and bearing row of setiferous punctations. Opposable margin of dactyl with distinct excision at base supporting row of 3 tubercles followed by row of 5 in antepenultimate fourth of finger, single row of minute denticles present between and distal to latter row; mesial surface of finger with 2 (left with row of 3) tubercles near base followed by row of setiferous punctations.

Carpus of cheliped longer than broad with oblique furrow dorsally; mesial surface with 1 large, conical, corneous tubercle and 2 rudimentary ones proximal to it; dorsomesial distal angle corneous, dorsal surface punctate; ventromesial surface with arc of 3 tubercles leading to more mesial one of 2 situated on ventrodistal margin of podomere.

Merus of cheliped with 2 oblique dorsal rows of 3 tubercles each, two distalmost members larger than others and subacute; dorsomesial distal margin produced in conspicuous, weakly scalloped prominence; ventral surface with mesial row of 12 tubercles and lateral one of 6, only 1 or 2 tubercles not in linear series. Ischium with 1 (2 on left) tubercle ventromesially.

Hook on ischium of third pereiopod (Fig. 1e) simple, robust, overreaching basioischial articulation, and not opposed by tubercle on corresponding basis. Coxae of fourth and fifth pereiopods without caudomesial boss, mesial caudoventral angle of that of fifth with prominent tubercle.

Sternum between third, fourth, and fifth pereiopods comparatively shallow; ventrolateral margins with plumose setae obscuring much of first pleopods.

First pleopods (Fig. 1b, g, k, l) as described in "Diagnosis." Setae at caudal base splayed as in *Procambarus* (*G.*) *regalis.*

Uropods with mesial lobe of basal podomere produced in distally projecting spine; mesial ramus with distomedian spine small and premarginal; distolateral spine present on mesial and lateral rami.

Allotypic female.—Differing from holotype, other than in secondary sexual features, in following respects: tubercles in hepatic and mandibular regions not numerous but conspicuous; anterior extremity of rostrum rounded, not forming apical prominence; dorsal surface of rostrum concave posteriorly to base, subrostral ridges evident in dorsal aspect to base of apical curvature; postorbital ridges terminating anteriorly in minute corneous tubercles; very small branchiostegal spine present on right side; 2 or 3 tubercles present in position occupied by cervical spines in many crayfishes; cephalic section of telson with 2 spines in each caudolateral corner; (right chela regenerated exemplifying usual short mesial margin of palm and comparatively straight opposable margins of fingers) left chela (Fig. 1m) with opposable margin of fixed finger like that of left member in holotype; opposable margin of dactyl of chela with additional tubercle situated opposite distal, more ventral one on fixed finger; mesial surface of carpus of cheliped with small tubercle at proximoventral base of large tubercle; prominence on distal dorsomesial margin of merus with 2 distinct scallops; dorsal surface of merus with 8 tubercles, only 1 of which conspicuously larger than others. For measurements see Table 1.

Annulus ventralis (Fig. 1i) as described in "Diagnosis." Preannular plate membranous, not clearly delimited posteriorly; postannular sclerite broad basally, gradually tapering anteriorly with apical third sloping conspicuously dorsally and when pressed against annulus foreshortened so that anterior margin appearing broadly rounded. First pleopods comparatively well developed, reaching at least midlength of annulus when abdomen flexed.

Morphotypic male, form II.—Differing from holotype in following respects: areola shorter, constituting only 39.3% of carapace length; apex of acumen almost reaching distal margin of penultimate podomere of antennular peduncle; branchiostegal spines and cervical tubercles weak; cephalic section of telson with 2 spines in each caudolateral corner; cephalomedian projection of epistome minute; 8 tubercles in mesialmost row on mesial surface of palm, 6 in adjacent row, and 5 or 6 in more lateral curved row; dorsal longitudinal ridge well defined on dactyl; tubercle count on opposable margin of fixed finger 3 and 6 on right (tubercles abraded on left), 3 and 4 on that of dactyl of left chela (probably also on damaged right); dorsal distomedian angle of carpus produced in short spine, and 2 small spines between mesial and ventromesial spines; tubercles on dorsomesial distal prominence of merus more clearly defined. Hook on ischium of third pereiopod very weak, not nearly reaching basioischial articulation; tubercle on ventral caudomesial angle of coxa of fifth pereiopod reduced in size. First pleopod (Fig. 1c, f) with less conspicuous shoulder on cephalic surface, stouter mesial process, cephalic process not differentiated from poor-

Table 1.—Measurements (in mm) of the primary types of *Procambarus* (*G.*) *steigmani*, new species.

	Holotype	Allotype	Morphotype
Carapace:			
Entire length	28.4	32.9	24.2
Postorbital length	25.1	28.9	21.2
Width	12.8	14.9	10.6
Height	13.1	14.6	11.0
Areola:			
Width	linear	linear	linear
Length	11.9	13.4	9.5
Rostrum:			
Width	4.3	4.5	3.3
Length	4.4	4.7	3.8
Chela:			
Length, palm mesial margin	7.7	7.8	6.7
Palm width	10.2	10.0	7.1
Length, lateral margin	22.2	22.0	15.3
Dactyl length	13.0	13.2	9.1
Abdomen:			
Width, second segment	9.7	11.6	9.1
Length, total	25.9	28.9	21.4

ly defined processes of central projection, and lamella and thumb-like parts of caudal element less distinctly defined.

Color notes.—Holotype (Fig. 2): Dominant colors cherry red and pale blue. Carapace cherry red dorsally, slightly paler from posterior level of postorbital ridges anteriorly; ridges, lateral rostral carinae, and paired spots on posterior gastric region vermilion. Cervical groove and mandibular adductor areas dark reddish brown. Orbital region dark brown suffused with red; hepatic region dark red dorsally quickly fading anteroventrally to pink, lavender, and over antennal and mandibular regions very pale blue. Branchiostegites with dorsal red area sharply set off from lateral pale blue region along line from level of site usually occupied by cervical tubercle to dorsal end of caudal flange. Marginal ridge, caudal flange, and caudal ridge dark bluish gray. Dorsal surface of abdomen slightly paler red than posterior dorsum of carapace; second through fifth terga with paired dark purplish red, caudally-divergent spots dorsolaterally. Lateral limits of same terga marked by arched paler purplish red marks abutting pink pleura. Telson and uropods red, rami of latter with red fading toward borders; dark splotch situated caudomesially on mesial rami. Dorsum of merus and carpus of cheliped reddish brown with bluish to lavender blush; carpus with large distomesial spine and distomesial angle pinkish cream. Dorsal surface of palm of chela tan; area flanking base of dactyl darkened by bluish suffusion; most tubercles and punctations very dark, but proximodorsal articular condyle and mesialmost row of tubercles on palm pinkish cream. Both fingers pale blue with cream on proximal flank of corneous tips. Remaining pereiopods pinkish cream with bluish suffusion on merus and carpus, darkest at junctions of these podomeres. Ventral surface of all pereiopods and abdomen cream with pinkish blush. Podomeres of antennae and antennules cream to pale tan; flagella pale olive. Third maxillipeds mostly pinkish cream.

The color pattern of the allotype is almost identical to that of the male, but the coloring differs markedly. Carapace with dorsum chocolate brown setting off tannish cream postorbital ridges and rostral carinae. Terga of abdomen reddish brown and pleura cream. Uropods and caudal section of telson pale pinkish tan, mesial ramus of uropods lacking dark caudomesial splotch. Pereiopods as in holotype except lacking pinkish suffusion. The morphotype bore the same coloration as the holotype; however, the reds were more subdued.

Size.—The largest specimen available is a first form male having a carapace length of 37.0 mm (postorbital length of 32.7 mm). The smallest first form male has corresponding lengths of 28.3 and 25.0 mm. Measurements are not available for either ovigerous females or ones carrying young; for those of the primary types, see Table 1.

Type locality.—Parkhill Prairie, a 52 acre tract of grassland in the Trinity River basin, 9.4 miles (15 km) north of U.S. Highway 380 off State Highway 36, Collin County, Texas (33°16′N, 96°18′W). The soil on the Prairie belongs to the Houston Series which consists of calcareous clays that here are shallowly to deeply eroded. Among the conspicuous grasses are *Andropogon gerardii, Schizachyrium scoparium, Tripsacum dactyloides, Sorghastrum nutans, Bouteloua curtipendula,* and *Panicum virgatum.* In the spring, the wildflowers include the Indian paintbrush, White winecup, and Wild petunia and, in the fall, Maximilian Sunflower, Ironweed, and asters. There this crayfish along with representatives of *Procambarus* (*Girardiella*) *curdi* Reimer, 1975, occupy burrows that descend to an unknown depth below the surface. The burrows are marked by turrets consisting of pellets of soil that when dry are light gray in color, contrasting sharply with the green to brown grass. In an account of the discovery of this crayfish by

Ken Steigman, Eig (1990) included a photograph of the Parkhill Prairie and another of what appears to be a female of *P.* (*G.*) *steigmani.*

Disposiiton of types.—The holotypic male, form I, allotype, and morphotypic male, form II, are deposited in the National Museum of Natural History, USNM 220525, 220526, and 220527, respectively, as are the paratypes consisting of 10 ♂ I, 5 ♂ II, and 12 ♀.

Range and specimens examined.—All of the specimens available were obtained by K. Steigman from snake traps set in the type locality. Thus, all were crawling among the grass when they wandered into the traps: 6 ♂ I, 5 ♂ II, and 12 ♀ were taken on 14 Feb 1990, 1 ♂ I on 28 Apr 1990, 2 ♂ I on 28 May 1990, and 1 ♂ I, date uncertain. In addition, the primary types were, among other specimens, perhaps lured into a trap during a dry spell in late June or early July (when 5 to 8 cm cracks penetrated a meter into the soil) by introducing into the trap water-soaked foam rubber in an open ziplock bag.

Variations.—All of the specimens that I have examined are from the same locality, and the variations noted among them are minor ones, many, if not most, associated with injury in earlier instars. The rostrum reaches anteriorly between the proximal ends of the penultimate and ultimate podomeres of the antennular peduncle. Branchiostegal spines, which at most are small, may be vestigial or lacking. Tubercles along the posterior flank of the cervical groove, one of which a probable homologue of the cervical spine, may or may not be present; the postorbital ridges may terminate anteriorly in a minute, corneous tubercle or may merge imperceptibly with the surface of the orbital area; the ridges are sometimes so depressed just posterior to midlength as to appear almost bipartite. The paired sclerotized knobs in the posterior gastric region are not always discernible. The mesial lobe of the proximal podomere of the uropod is not always produced into a spine; it may even be truncate. The most readily recognized variations occur in the number of tubercles on the several podomeres of the cheliped: the ventromesial surface of the ischium has 2 or 3; 6 to 8 tubercles occur in the dorsal surface of the merus where usually 2 are spiniform (rarely 1 or 3), the ventromesial row consists of 9 to 14 and the ventrolateral one of 4 to 7; the number of tubercles in the arc on the ventromesial surface of the carpus ranges from 0 to 4; the mesialmost row of tubercles on the palm of the chela consists of 6 to 8, 5 to 8 in the adjacent dorsolateral row, and 4 to 7 in the more lateral curved row; the opposable margin of the fixed finger exhibits 2 to 4 tubercles proximal to the first large tubercle and a continuing row of 4 to 6 more distally; the corresponding margin of the dactyl bears 3 or 4 in the basal concavity and 4 to 8 more distally, 1 to 3 tubercles are present on the proximomesial surface of the finger.

Relationships.—*Procambarus* (*G.*) *steigmani* has its closest affinities with *P.* (*G.*) *regalis* and, as suggested in the introductory remarks, may well prove to be a subspecies of the latter which is currently known only from the Ouachita and Red river basins of southwestern Arkansas (Hobbs & Robison 1988:fig. 15). The similarities between the two include almost identical terminal elements of the first pleopods in the male, thickened rostral margins, postorbital ridges that are swollen posteriorly, chelipeds that are markedly similar, and color patterns that also betray a close common ancestry. Features that seem most reliably to distinguish them are the following found in the new species: an asymmetrical arrangement of the first pleopods, the first recorded for a member of the subgenus *Girardiella*; the absence of tubercles on the ventral surface of the palm of the chela; the strongly tuberculate annulus ventralis, and the cherry red and pale blue coloration of the male and the chocolate brown color noted in the female. Should these colors prove to be typical of the species they will furnish a ready diagnostic character for recognition of the crayfish in the field. In *P.* (*G.*) *regalis,* the pleopods of the male are always symmetrically situated; at least a few tubercles are always present on the ventral surface of the palm of the chela, and in only one specimen [collected 1.5 mi (2.4 km) N of Paraloma, Sevier County, Arkansas] that I have examined do the anterolateral prominences of the annulus approach the tuberculate condition that appears to be typical of *P.* (*G.*) *steigmani.* The colors of the carapace of *P.* (*G.*) *regalis* as recorded by Hobbs & Robison (1988) are brownish red and tannish cream, not nearly so brightly colored as are the males of the new species.

Etymology.—It is a pleasure to name this crayfish in honor of its discoverer, Ken Steigman.

Acknowledgments

Thanks are extended to K. Steigman of the Heard Natural Science Museum and Wildlife Sanctuary, McKinney, Texas, for providing me with the specimens on which this description is based and for information concerning the type locality and the few habits of the crayfish reported here. Appreciation is also extended to J. F. Fitzpatrick, Jr., of the University of South Alabama, H. H. Hobbs III of Wittenberg University, and my colleague T. E. Bowman for their comments on a draft of this manuscript.

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